RELATION OF PRECIPITATION TO TREE GROWTH.

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Some time ago I had the fortune to read "The Secret of the Big Trees," by Ellsworth Huntington. His work and its interesting results led me to make a series of measurements of an oak stump near my home. My purpose was to discover, if possible, whether the precipitation of previous years directly affected the ring widths; and, by means of ring measurements, to determine the comparative amounts of rainfall during periods for which no records exist.

The tree, an oak, was cut in February, 1913. The stump measurements were made partly in June and partly in August, 1913. One hundred and thirty-two rings were counted in all, but only the outer 70 have been used, as the inner rings were too compressed to be accurately measured by the instruments at hand.

Within this limit of 70 years, the results are not at all what were hoped for, but nevertheless they show a correlation of growth and rainfall. The chief difficulty lies in the fact that the nearest Weather Bureau station from which records can be secured is Rochester, 25 miles north. The rainfall data are from that station's record, and allowance must be made for considerable possible difference in the amounts at the two places. There is the possibility that two rings may have formed in some year, thus upsetting all calculations, but this does not seem to be the case. Sometimes, too, growth is checked by insect pests. Such may be another source of error.

From a study of precipitation data it first appears that annual rainfalls can not be used, since there may be great winter rains and snows which do not penetrate the frozen ground and have no effect on vegetable growth. Comparisons are therefore confined to the precipitation during the growing season. Hartig says this lasts four months for the oak. According to Freiderich the first period begins the latter part of April and continues through May with a decrease in mid-June. Then growth increases to a maximum in July and ceases in mid-August. In support of this statement the rainfalls during June and July seem to show closer correspondence, in their variations, with the ring widths than does the rainfall for the whole growing season. No separate measurements were made of the porous and compact woods in the rings. In one case, however, in 1875 an unusually wide spring growth was noted.

The center of growth was northwest of the true center, and as the tree had been felled to the north, leaving a jagged stub, no rings were measured on the north side. The measurements here given were taken on the east, southeast, and south radii, those on the east radius being continued to the center of growth, but not used for comparison. A mean was obtained from the three radii, and the true ring width taken from this. The narrowness of the outer rings can be attributed to the slower growth of the tree in its later years.

Although temperature records have been examined, no conclusion has been reached as to the effect of heat in favoring growth, or vice versa.

Here are some of the facts to be obtained from an examination of the data for the past 75 years:

The average ring width for this time is 4.9 mm.

The normal rainfall from March 1 to September 1 at Rochester is 14.46 inches. That for June and July, 6.26 inches.

Thirty-one years show a mean ring width of 5.8 mm. or more. In 26 of these 31 years there was a rainfall of over 4 inches in at least one month of the growing season (while 3.21 inches is the highest average for any month in the year).

Of 16 years with 6.5 mm. or more, 13 had over 4.50 inches in at least one month of the growing season.

Of 6 years with 7.2 mm. or more, 4 had over 4.60 inches and 3 had over 5 inches.

Sixty-three per cent of the rings are of more than average width, and 62 per cent of these were accompanied by more than average rainfall in June and July.

Of 15 rings less than 4.5 mm., only 3 had normal rainfall in the growing season. Of the 8 which were less than 4 mm., only one had normal rainfall.

SUMMARY.

June and July precipitation seems to have most effect upon the width of oak rings. Decrease of width more than 0.5 mm. below normal would appear to be quite certain indication of a subnormal summer rainfall. On the other hand, an increase in width is not so surely an effect of extra-abundant rainfall, though this holds in 62 per cent of the cases.

In neither case, however, does the width necessarily vary in the same ratio with the rainfall, for there are other unknown factors having a disturbing influence—temperature, insect pests, height of surrounding timber, etc.

To check up these conclusions and develop them to a greater extent, similar experiments should be made on trees nearer to a station from which precipitation records of early date can be obtained.

I wish to thank the following for valuable suggestions: Profs. Herman L. Fairchild, Charles W. Dodge, and William D. Merrell, of Rochester University; and Mr. David Leathersich, Caledonia, N. Y.

ABRIDGED TABLE OF THREE-RING MEASUREMENTS AND PRECIPITATION.

The writer has prepared tables showing ring widths on east, southeast, and south radii, and the mean of these three measurements together with precipitation data as far back as 1843 and east radius measurements as far back as 1785.

Year.	Mean width of ring from measurements on east, southeast, and south radii.	Precipitation.	
		June and July.	March to July, inclusive.
	Millimeters.	*Inches.*	*Inches.*
1912	4.4	3.67	13.64
1911	4.1	6.39	12.97
1910	3.7	4.75	11.33
1909	3.1	1.40	14.30
1908	4.0	8.20	16.19
1907	3.1	3.11	9.47
1906	3.2	6.32	12.45
1905	4.2	9.88	14.92
1904	5.2	6.91	17.20
1903	4.7	6.21	13.43
1902	4.6	8.51	14.14
1901	3.7	5.33	16.20
1900	3.8	6.41	15.24
1899	4.1	3.91	11.85
1898	5.2	2.92	9.92
1897	5.2	8.99	15.09
1896	7.2	7.55	16.60
1895	4.4	3.44	10.48
1894	6.2	6.35	17.09
1893	5.8	3.81	15.28